Growing a Crop of Algae on Dairy Manure

The first outdoor test of using algae to clean liquid manure from dairy barns has begun at a U.S. Department of Agriculture research center in Maryland.

Agricultural Research Service microbiologist Walter Mulbry has installed an algae scrubber system near the center's 300-cow dairy barns.

The algae grow in four raceways that are each 50 meters long by 1 meter wide. A similar system is used to treat wastewater from high-density ponds used for fish farming, and on a much smaller scale, in some home aquariums.

For lab prototypes for the full-scale algae scrubber system, Mulbry borrowed small algal turf scrubbers from Walter Adey, director of the Smithsonian Institution's Marine Systems Laboratory at the Museum of Natural History in Washington, D.C. Adey invented the algal turf scrubber as a natural and highly efficient way to clean fish waste from a living coral reef exhibit.

Dairy farmers usually store liquid manure in holding ponds or lagoons and then spray it on field crops. Ammonia escapes into the atmosphere during manure storage and spraying. Phosphorus from field-applied manure can be carried by rain runoff into streams, ponds, lakes, and estuaries, where it can spur excessive algal growth and other associated problems.

Mulbry says that in lab tests the algal scrubbers did a good job of removing most of the ammonia nitrogen and phosphorus from diluted dairy manure.

"Our system eliminates almost all losses of ammonia and nitrate as well as most, if not all, phosphorus losses," Mulbry says. Mulbry tested both raw and treated manure, but the lab results for raw manure are not in yet.

The outdoor tests will check the feasibility of dairy farmers growing algae year-round. The algae will grow on mesh screens lining a series of parallel, shallow raceways. Diluted liquid manure will be dumped at the end of each raceway, flowing in waves down its length.

The algae will be mechanically harvested weekly. The screens will be rolled up and the algae scraped from them.

Once harvested algae could be dried and made into high-protein feed for livestock and fish. Other possible products: fertilizer and high-value chemicals.

To check on the algae's nutritional value, Mulbry will collaborate with animal nutritionists to conduct livestock feeding tests.

Two of the raceways will have a 1-percent slope, while the other pair will have a 2-percent slope, to check the effect of slope and flow on algal production.—By **Don Comis,** ARS.

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Alarm Pheromone Knocks Off Russian Wheat Aphids

The Russian wheat aphid is a major pest of winter wheat and barley in the United States and worldwide. First identified in 1986 in the United States, the green, 1/16-inch-long *Diuaphis noxia* had cost U.S. growers $1 billion by 1993.

Last year, cumulative yield losses topped 106 million bushels and infestation of small-grains crops totaled over 20 percent throughout the pest's North American range—16 states and 2 Canadian provinces.

Searching for ways to outwit the pest and keep it from spreading, John D. Vandenberg, of the U.S. Plant, Soil, and Nutrition Laboratory in Ithaca, New York, and colleagues Paresh A. Shah and John A. Pickett from the Institute for Arable Crops Research in Harpenden, England, made some new discoveries.

The team found that the Russian wheat aphid may produce the alarm pheromone (E)-ß-farnesene and showed that the pest responds to it.

Alarm pheromones are produced by some aphids in response to a disturbance. Their effect is to stimulate movement by nearby aphids—a response that may help the pests avoid predators.

"(E)-ß-farnesene is a common alarm pheromone among aphids," Vandenberg says. "They release it from their rear abdomen, where it is secreted when they are attacked by arthropods. A forced behavior, such as dropping off the host plant, may help aphids avoid enemies."

Vandenberg and colleagues studied the Russian wheat aphid's response to a synthetic form of the green peach aphid's alarm pheromone.

Vandenberg also evaluated the pheromone's effectiveness in combinations with an aphid-infecting fungus, *Paecilomyces fumosoroseus,* in hopes that alarmed on-the-move aphids would be more likely to become infected.

In a series of lab tests, the researchers found that aphids responded to the alarm pheromone by removing their feeding tubes, or stylets, from barley leaves and crawling out of test areas. They left even more quickly when the pheromone concentration increased.

But combinations of (E)-ß-farnesene and the aphid-infecting fungus did not enhance aphid mortality.

Vandenberg says, "Further studies are needed to determine whether the pest actively secretes alarm pheromones in response to natural disturbances. Studies are also needed to explore the possible synergy between pheromone applications and other control agents."—By **Hank Becker,** ARS.

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